Article

# Effects of different footwear on distribution of hip-joint contact stress

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Background

Although running is physiologically valuable, it leads to a high rate of chronic disorders. The hip is a common injury site, accounting for 15% of injuries. Stress distribution is a key biomechanical variable linked to the aetiology of arthrosis. Athletic footwear is a key extrinsic mechanism by which chronic injuries are controlled. The current study aimed to assess the effects of running footwear on distribution of hip-joint stress.

Methods

22 male runners (mean age 24·56 years, SD 4·54) were examined with an optoelectric three-dimensional (3D) motion capture system and a force plate. 3D hip-joint forces were quantified with a Pythagorean approach to provide the resultant hip-joint force. Hip-joint stress was obtained via a musculoskeletal modelling approach which used the 3D hip forces, femoral head diameter, and centre edge angle as inputs. Differences according to footwear were examined with repeated measures ANOVA. The study was approved by the University of Central Lancashire Science, Technology, Engineering, Medicine and Health ethics panel (reference number 361).

Findings

The findings revealed a main effect for peak resultant hip-joint force (p=0·016, I2=0·31). Follow-up analyses showed that peak resultant hip-joint force was significantly reduced in minimalist footwear conditions (mean 3·78 m/s times body weight [SD 0·74]) compared with maximalist (4·13 [0·80], p=0·017) and conventional (4·05 [0·60], p=0·020) footwear conditions. In addition, a main effect was also noted for peak hip-joint stress (p=0·041, I2=0·25). Follow-up analyses showed that peak hip-joint stress was significantly reduced in minimalist footwear (mean 1·58 MPa [SD 0·26]) compared with maximalist (1·73 [0·30], p=0·040) and conventional (1·72 [0·21], p=0·041) footwear conditions.

Interpretation

The key clinical observation from this exploratory analysis is that minimalist footwear significantly attenuated peak resultant hip-joint force and peak hip-joint stress. Since excessive loading and stress

distribution at the hip-joint has been associated with the aetiology of hip-joint disorders, the current investigation indicates that minimalist footwear might reduce runners' susceptibility to chronic hip disorders.